DOCUMENT RESUME

ED 229 001 IR 010 684

AUTHOR Pitts, Marcella R.
TITLE The Educator's Unauthorized Microcomputer Survival Manual.
INSTITUTION Council for Educational Development and Research, Washington, D.C.
PUB DATE [82]
NOTE 65p.
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Computer Assisted Instruction; *Computer Literacy; *Computer Oriented Programs; *Computer Programs; Elementary Secondary Education; Evaluation; Glossaries; *Microcomputers; *Program Development; Programing Languages; Specifications
IDENTIFIERS *Computer Uses in Education

ABSTRACT

Designed for anyone facing decisions about where, how, and even whether they will use microcomputers for instruction, management, or administration, this manual emphasizes that computer technology, particularly microccmputer technology, is neither all good or all bad for schools. It was developed to discuss the pros and cons of computer technology and to offer some strategies educators might use to survive the influx of microcomputers into schools. Specific chapters address the topics of (1) the need for an unauthorized survival manual; (2) survival tactics in the microcomputer revolution; (3) computer terminology and literacy; (4) putting the microcomputer's promise into perspective; (5) deciding how to use a microcomputer; (6) evaluating computer programs; and (7) selecting the right microcomputer. An appendix includes a short guide to computer terms, a checklist of possible microcomputer uses, instructional software review questions, and criteria for judging microcomputer hardware and for rating hardware systems. Nine references, a list of Council for Educational Development and Research member institutions (with contact information), and an index complete the guide. (LMM)

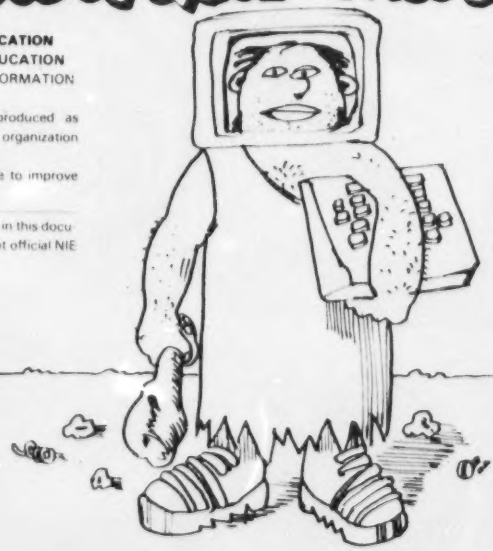
****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED229001

The Educator's Unauthorized MICROCOMPUTER Survival Manual

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

- This document has been reproduced as received from the person or organization originating it.
  Minor changes have been made to improve reproduction quality.
- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.



By Marcella R. Pitts
Council for Educational Development and Research
Washington, D.C.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Marcella R. Pitts

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

IR010684

A portion of the cost of producing this product
has been supported from a subcontract under a grant
from the U.S. Department of Education,
National Institute of Education. The contents
of this publication do not necessarily reflect
the view or policies of the National Institute of
Education, or the U.S. Department of Education, nor
does any mention of trade names, commercial products,
or organizations imply endorsement by the
U.S. Government.

DESIGNED AND ILLUSTRATED BY BURKEY BELSER, INC., WASHINGTON, D.C.

Contents

I. Why an Unauthorized Survival Manual i

II. Survival Tactics in the Microcomputer Revolution

- Survival Tactics For Whom? 1
- Is There Really a Microcomputer Revolution? 1
- What Are Technology Survival Skills? 3

III. You Too Can Sound Like a Computer Wizard

- Mastering Some Jargon 5
- Becoming Computer Literate 6

IV. Putting the Microcomputer's Promise Into Perspective

- What Microcomputers Might Do For You, Someday 9
- What Microcomputers Can (and Can't) Do For You, Today 9
- Organizing for Microcomputers 17

V. Deciding How You'll Use a Microcomputer

- What You Know That the Experts Don't 19
- Planning Your Use of a Microcomputer 20

VI. Sorting Out the Good Computer Programs From the Bad

- Sorting Out the Good Computer Programs from the Bad 25
- Using Your Educational Expertise To Judge Software 26

VII. Selecting the Right Microcomputer

- Preparing for the Computer Vendors 29
- Talking to Computer Vendors 31
- Comparing Microcomputer Systems 33
- A Final Word 35

VIII. Appendix 36

- A Short Guide to Computer Terms 37
- Possible Microcomputer Uses 44
- Instructional Software Review Questions 46
- Criteria for Judging Microcomputer Hardware 49
- Rating Hardware Systems 51

IX. References 53

X. CEDaR Institutions 54

XI. Index 57

Why an Unauthorized Survival Manual?

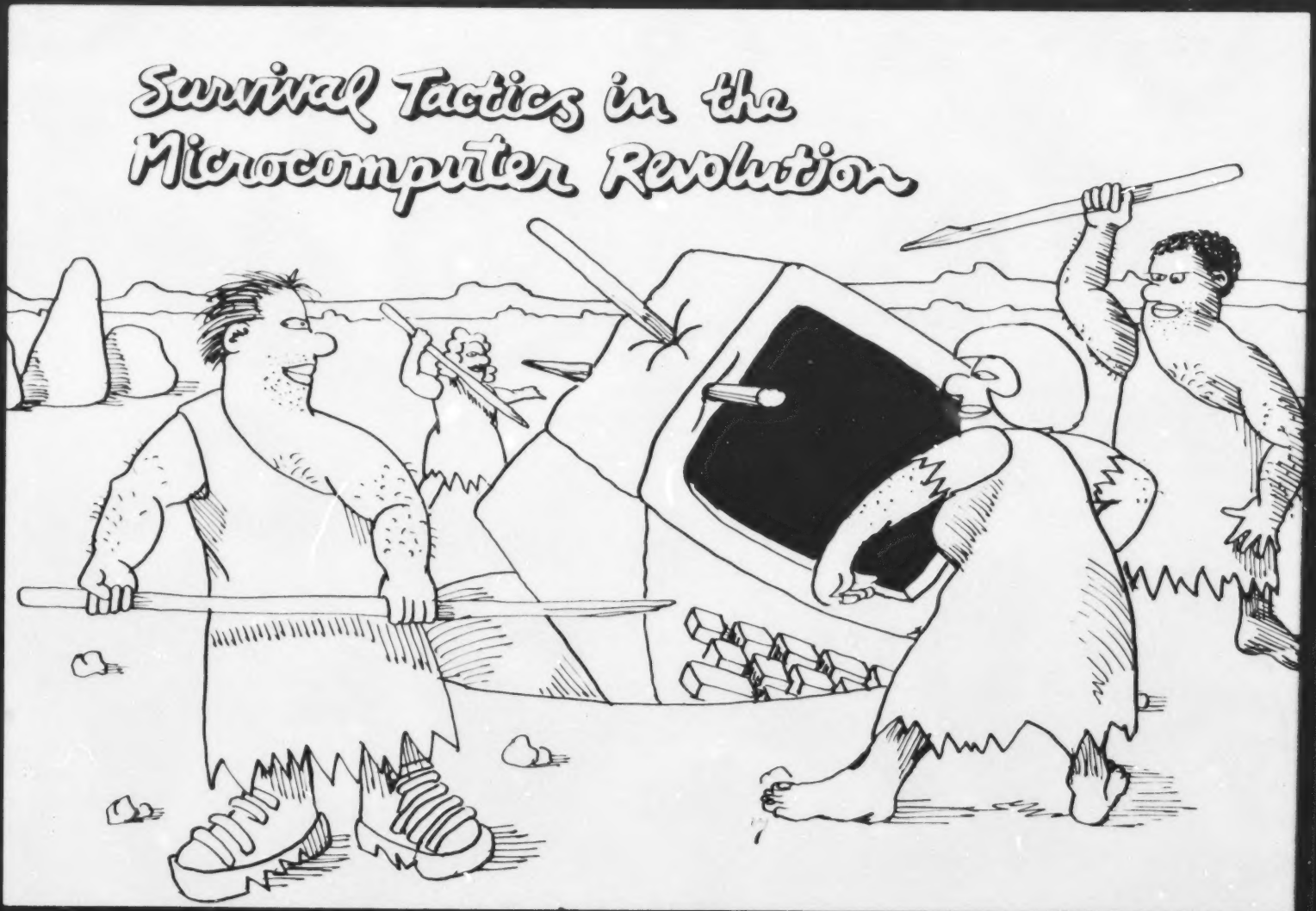
Right or wrong, well-advised or not, more and more schools are entering the technology age. And many people view schools' use of innovative technology as beneficial to education. This includes the Secretary of Education who has launched a four-year, multimillion dollar technology initiative to bring schools into the technology age. Education magazines and journals abound with articles about the benefits of technology, particularly the small, affordable personal computers known as microcomputers.

This manual's view of technology in education differs from the enthusiastic, media-promoted view of technology's role in education. The manual delivers a message that's different from what you'll hear from technology enthusiasts in government and from computer manufacturers backing legislation to increase the number of microcomputers in schools. Hence, "unauthorized" in the title.

The manual is designed for anyone facing decisions about where, how, and even whether they will use microcomputers for instruction, management, or administration. It is a "survival" manual because computer technology, particularly microcomputer technology, is neither all good nor all bad for schools. There are disadvantages as well as advantages, and the chances of becoming a victim of technology are just as great as the chances of becoming a master of the technology. Survival skills which couple educational expertise with some technological savvy are critical.

The manual was produced by a Washington-based nonprofit association consisting of educational research and development organizations concerned about technology in education. These organizations agreed to work together to develop a resource for school personnel. The purpose: to discuss the pros and cons of computer technology and offer some strategies educators might use to survive the influx of microcomputers into schools and possibly turn the much talked about "microcomputer revolution" to their advantage.

The manual reflects the thinking and contributions of many people. It was developed in conjunction with Audrey Champagne and Joan Saz of the Learning Research and Development Center, University of Pittsburgh, who lent their considerable expertise to the project. Ron Baillie from the Allegheny Intermediate Unit in Pennsylvania provided valuable input and resource materials. The writer also relied extensively on the work of Henry Jay Becker of the Center for Social Organization of Schools, Johns Hopkins University. Richard Schutz, SWRL Educational Research and Development, kindly reviewed drafts of the manual and his comments and suggestions greatly improved the final product. Finally, E. Joseph Schneider, Council for Educational Development and Research, guided the development effort and came up with the manual's title, an invaluable contribution.


Survival Tactics in the
Microcomputer Revolution

Survival Tactics For Whom?

This microcomputer survival manual is written for educators who by choice or circumstance are joining the "microcomputer revolution." Its survival tactics are for anyone with: 1) guarded enthusiasm (or cautious optimism), and 2) a more thorough understanding of education than the ins and outs of computer technology.

This manual is for those who include themselves in these ranks. It is for educators who, with limited time, resources, and technical background, must make decisions about how, why, when, and where to use microcomputers in schools or classrooms.

If you're a technology enthusiast with one microcomputer in your classroom and another in your home, you're probably familiar with many of the issues covered in the manual. And you may find its caveats unfounded. Similarly, if you have a deep seated aversion to technology and even refuse to utter the word "microcomputer," you've devised your own survival tactic and won't need the strategies outlined in the manual. But, if for one reason or another, you've decided to face the revolution and *make* the technology work *for* you, read on.

Is There Really a Microcomputer Revolution?

Characterizing schools' current use of microcomputers as a revolution is a bit exaggerated. But the term makes good copy for headlines in popular and professional media, and in unauthorized microcomputer survival manuals. It's also a handy reference for those who want to sell microcomputer systems to schools.

In education there is, as yet, less to the revolution than meets the eye or ear. Scratch below the surface of enthusiasm and you find the revolution is overstated.

Granted, some districts are using computers extensively, and more significantly, they're using them in instructional applications. These districts serve as notable examples for those interested in adopting the technology, although they're still in the minority. More schools will have to embrace the microcomputer as an instructional tool to justify claims that this new technology will revolutionize teaching and learning.

Undeniably more and more schools *are* beginning to use microcomputers in classroom instruction. The National Center for Education Statistics (NCES), for example, tells us the number of personal microcomputers available for instructional use by public school students tripled between fall 1980 and spring 1982. By the spring of 1982, students had access to 120,000 microcomputers and computer terminals. NCES verifies other predictions that both

the total number of computers and their availability in public schools is expected to increase. In the 1982-83 school year alone, it expects the number of computers used for instruction to increase by about 52,000. And almost all of this increase—95 percent—will be microcomputers.[1]

These numbers are impressive. But consider the dramatic increases that would be required before a broad range of students have access to the equipment for long periods of time—periods of time needed if students are to learn from these machines. Consider the number of pieces of equipment needed if schools intend to use microcomputers and computer terminals to instruct the 45 million currently enrolled in elementary and secondary schools. During 1981-82, for example, nearly 5 million students used computers but that averaged out to only 9 hours of computer access for each student during the year.

In the final analysis, equipment is still spread rather thinly across our 2 million elementary and secondary classrooms. Even with a 50 percent annual increase in microcomputers in schools and no change in the number of older terminal systems, by 1986 there will be only about three computers per school or 1 for every 8 classrooms nationwide.[2]

The sheer number of machines influences how educators use the technology. Certainly, the day when each stu-

dent will work at his or her own microcomputer on a highly individualized program is well in the future. At best, the revolution is just beginning.

Schools typically join the fledgling revolution on the initiative of enthusiastic teachers or administrators. You may be such a teacher or administrator. Or you may have decided to pick up this manual because you're involved in a statewide or local initiative to increase the use of computer technology in schools.

Computer technology may be filtering into your school in a gradual, random way. Or the powers that be may have decided that now, right now, is the time to adopt computer technology. In either case, the technological survival skills outlined in this manual may come in handy. These skills, coupled with your administrative, instructional, and management skills, will put you in a good position to cope with the microcomputer revolution.

What Are Technology Survival Skills?

Technology survival skills are nothing more than skills educators already possess. . . topped off with modest additional savvy.

Happily, the ability to manage technology draws heavily on educators' existing skills and experience. Many of the decisions require the administrative, management and instructional skills you already have. For example, your knowledge of what constitutes good instruction (computer-based or not) and your understanding of the technology needs of your school or classroom will prove invaluable.

Bringing your educational expertise and experience to bear on decisions involving technology requires some technological savvy. Such savvy includes:

1. Knowledge of exactly how, where, when, and why you'll use a microcomputer;
2. Knowledge of the appropriate questions to ask when judging computer programs and selecting computer hardware; and
3. Knowledge of computer terminology useful in talking to the "experts."

These technology survival strategies are covered in the manual's remaining chapters.

You Too Can Sound Like
a Computer Wizard

Mastering Some Jargon

Those who work with computers speak a technical language usually unfamiliar to anyone but other professionals in the computer field. Conversations run to bits and bytes, RAM and ROM, CPU's and CRT's. Computer professionals speak of programming, interfacing, coding, and executing. They worry about compatibility, access and response time, and noise in the system.

These and other terms make up a kind of technical shorthand. It is a common language used to talk about parts of a computer system, how they function, what they can do, and how people can control them. Educators who do not understand and cannot use some of this shorthand are at a disadvantage. Very simply, educators speak one language; the people who market computer equipment (i.e., hardware) and those who develop computer-based programs (i.e., software) speak another.

Generally, computer specialists are not educators, and the economics of the marketplace do not demand that they develop on-the-job skills to work with educators. After all, when compared to the business and home markets, the education market is still quite small. This situation may change over time, especially as groups like textbook publishers move into the instructional software market. But for the present, the burden to develop technical communication skills rests with the educator who seeks information on computer technology.

As an educator investigating the uses of technology, you might spend some time familiarizing yourself with essential terms. In this way, you can sound like a computer wizard. Armed with some basic computer terms, you can couch your hardware and software needs in language industry spokespersons can understand, a technology survival strategy that increases the chances of selecting programs and equipment suited to your needs.

"A Short Guide to Computer Terminology" in the survival manual's appendix defines some of the more common computer terms.[3]

Becoming Computer Literate

Educators venturing into the world of computer technology put their computer expertise on the line time and time again. Just how computer literate are you? the experts will wonder.

Computer literacy is often heralded as the basic skill of the future. Its importance is ranked with reading, writing, and arithmetic. Predictably, this nomination puts pressure on educators to develop their own computer literacy skills.

At best, computer literacy is an ambiguous term used by different people to mean different skills and knowledge related to computers, communications, and information handling. For example, courses elementary and secondary schools offer under the label of computer literacy vary widely. Who developed the course, their definition of what it means to be computer literate and their own level of expertise affects what is taught. So does the length of the course, the grade level, and the availability of computer hardware.

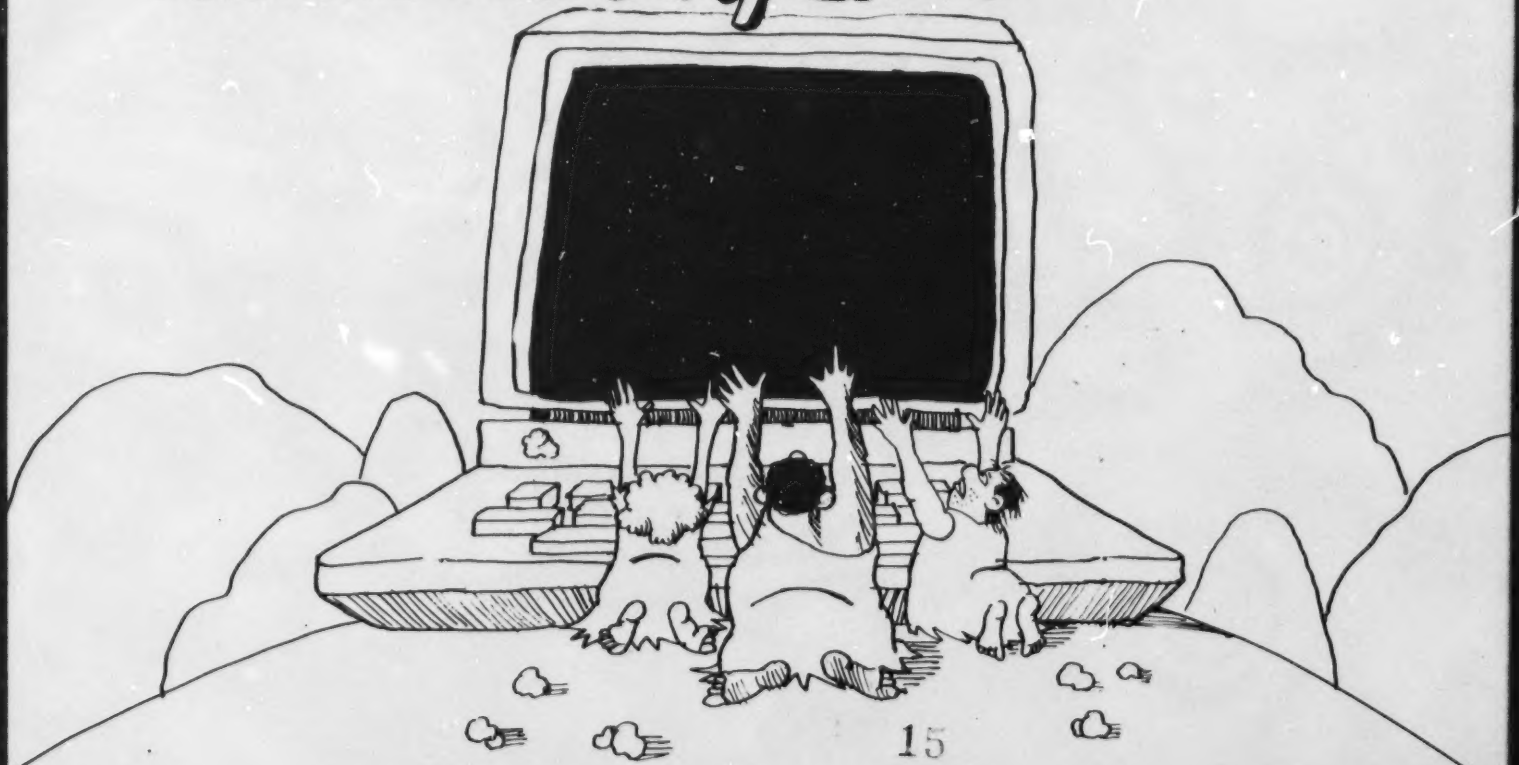
The question of what students and school staff should learn about computers to become computer literate has been debated by professional groups since computers were first introduced into schools in the 1980s. Some maintain a teacher must learn computer programming to be considered computer literate. Others disagree. For some teachers computer literacy might include the ability to

write a simple computer program — a set of instructions directing the computer to perform a certain operation. Others who may be called upon to teach programming will need to develop more advanced skills. But these educators are in the minority.

Becoming computer literate for the majority of teachers, administrators, librarians, and other school and district staff interested in instructional uses of computers includes two basic survival skills:

1. Becoming familiar with the instruction-related tasks the microcomputer can be expected to perform; and
2. Becoming experienced in using the microcomputer with packaged instructional programs and for text preparation, editing, and test scoring.

Putting the Microcomputer's Promise into Perspective



What Microcomputers Might Do For You, Someday

As an educator taking the time to read a microcomputer survival manual, you've probably decided these small, relatively inexpensive systems are potentially useful and versatile tools. By and large, that's a fair assessment. But your chances of putting this technology to good use are increased by adding to your list of technology survival skills the ability to put the microcomputer's promise into perspective. This means weighing the technology's potential against the realities of current and probable educational usefulness in the next 5 to 10 years. This doesn't imply that you shouldn't use the technology. It does suggest, however, that you might consider what the technology can and cannot do for you so that you have a complete sense of what you might be getting into.

The microcomputer's promise as an instructional, administrative, and managerial tool is impressive. In the area of instruction, for example, there are visions of classrooms where some students will hold dialogues with intelligent computer tutors that function like master teachers. Other students will test scientific principles through computer-generated simulations. Still others will use computer programs to practice reading, language arts, and arithmetic skills, create musical patterns, and write school reports. The computer's display screen will serve as a writing pad, a calculator, a dictionary. It will be a tool to access reference materials, and a means to experience through simulations that which is too costly, risky, time consuming, or otherwise impossible to bring into the classroom.

What Microcomputers Can (and Can't) Do For You, Today

Rapid advances in hardware capabilities, matched by decreasing equipment costs, and increased availability of computer-based educational programs suggest computer technology might well live up to its promise.

But restricted funds, limited access to microcomputer hardware, educators' inexperience with the technology, and the short supply of high-quality, computer-based programs suggest computers' use in schools may fail to meet expectations.

Consequently, it's important to consider what computer technology and microcomputers can realistically offer as an instructional and administrative tool. A good place to begin is a listing of the most common uses of microcomputers in schools.

The survival manual describes some advantages and

limitations of seven applications of microcomputer technology:[4]

1. Drill and Practice
2. Tutorial Dialogue
3. Simulations
4. Computer Literacy
5. Computer Programming
6. Instructional Management
7. Administration

1. Drill and Practice. In this application, the least exciting but most common use of the computer in education, students use the computer to sharpen skills that have already been taught by the teacher. The computer doesn't teach anything new. Rather, it reinforces what's already been introduced during instruction. Basically, the computer presents a question or problem, the student responds, the drill and practice program tells the student if the answer is correct or incorrect, and the student moves on to the next item in the program. Repetition of similar exercises and immediate reinforcement are key elements of drill and practice programs.

Typical programs provide drill and practice in math facts, spelling, word recognition, history facts, and the like — all routine learning activities which students master through repetitive practice. Since these are taught in the early elementary grades, most drill and practice programs are designed for the early grades.

Computer-based drill and practice has some real advantages over more traditional forms of drill. It is interactive and flexible and can be more enjoyable. In addition, it provides students with direct and immediate feedback on their performance. Last but not least, drill and practice programs are easy to write, particularly in math and other subjects where program authors can use multiple choice questions.

Limited research information shows that drill and practice programs can be effective under certain conditions. Conditions include enough equipment for each student, a well-written program, and careful monitoring by the teacher.

However, the advantages and potential effectiveness of drill and practice programs are tempered by some disadvantages. Most programs, for example, provide approval for correct answers. If the student makes a mistake, they will tell the correct answer and give the student a second try. But they don't do an error analysis and tell students why their answer is wrong. And like the programmed instruction workbooks they resemble, many are repetitious and

boring. Then too, they focus on limited sections of the school curriculum (e.g., multiplication tables, long division). Since they aren't keyed to any text, the teacher must figure out ways to incorporate them into the curriculum.

All in all, educators who plan to use their microcomputer solely for drill and practice may find this application a disappointing use of the technology.

2. **Tutorial Dialogue.** Tutorial programs are more sophisticated than drill and practice programs. They can monitor students' progress through material, introduce remedial and review segments if the student is having trouble, and even skip over some material. In tutorial dialogue, there's a shift from the repetitive questions in drill and practice programs to the presentation of concepts. The computer begins to assume more of a "teaching role."

Tutorial programs themselves range from the simple to the sophisticated. For example, in simple programs, the computer presents information and questions, and compares the student's response to the correct answer. Depending on whether the student's answer is right or wrong, the program either branches to remedial information or moves on to the next sequential piece of information. In contrast, sophisticated programs, called "intelligent computer-assisted instruction," actually model the student's understanding of a topic and provide a dialogue based on this assessment. These programs are capable of determining the most beneficial point for offering the student some hints, the kinds of hints to offer, and how much emphasis to place on concepts and examples.

In contrast to drill and practice programs, which dominate the market, few tutorial programs are commercially available and fewer still have "intelligent" features. Most are simple programs that cover a small portion of textbook materials. They tend to be concentrated in mathematics and science, subject areas for which it's easier to develop tutorial programs to teach discrete concepts.

Tutorial programs, which require an enormous amount of programming and writing to develop, are expensive to produce. More important, the "instructional technology" needed to produce them is still limited. For computer-based tutorials to be effective, they must function like the most talented master teacher and interact with the student as that teacher would. However, neither the best teachers nor those who study ways to make instruction more effective, know completely what master teachers do to be so successful. Without this knowledge, it's difficult to develop programs modeled after a teacher's capability to tutor a student. At best, simple tutorial programs will continue to outnumber the "intelligent" programs.

Educators must consider whether simple tutorial programs which present facts, ask multiple-choice or fill-in-the-blank questions, and include some branching will provide them with any instructional advantage and whether they are worth the cost.

3. Simulations. That which students might not otherwise be able to experience can be brought into the classroom through computer-based simulations. A close substitute for actual experience, these programs can simulate situations in history, science, economics, the social sciences, or almost any other subject area.

Although simulation and model building programs are more exciting than their drill and tutorial program counterparts, few of these programs have been developed for the microcomputers schools now use. Of those available, few come with the supporting material needed to integrate the simulation into the curriculum, an omission that makes extra work for the teacher.

It's unfortunate there are not more commercially available simulation programs. They provide a practical way to make the best use of a limited number of microcomputers and unlike drill and practice and tutorial programs, simulations don't limit use to only one student at one time. Instead, a teacher with one microcomputer can use a simulation program as a focus of attention when instructing a small group of students or the whole class.

Generally, simulations present students with a model of a real life situation and the alternative actions they can take to deal with it. The student tries out these alternatives to discover what the program predicts will happen with each. In many cases, alternatives simulate options available in real life. In model building programs students can actually construct or modify the simulation model.

4. Computer Literacy. As discussed in an earlier section, people use the term computer literacy to refer to a whole range of skills. For some, it is awareness of how computers function and their current and future impact on society. For others it includes basic programming skills. Consequently, some computer literacy courses don't require computer hardware; others do.

The survival manual summarizes three common computer literacy applications:

1. Computer applications. This use acquaints students with the ways a computer-based system may affect groups of individuals; the importance of computer-related skills and experiences to a variety of careers; the ways in which computers are used by different people and organizations; the process used to apply a computer

to a problem area; uses of the computer-generated information; and the advantages and limitations of various applications.

2. Computer-related information skills. This application uses the computer to teach students and have them apply skills such as typing, composing and editing text, and manipulating databases to retrieve a particular piece of information. This application also provides experience in selecting and running a program and evaluating the usefulness of a program to accomplish a task.

3. Programming. This application, included as an optional part of a computer literacy course or as a separate course, is discussed below.

5. Computer Programming. By and large, programming is restricted to secondary schools, although there are strong arguments for and against its inclusion earlier in the curriculum. Those who argue pro and con base their views on a number of factors. These include their definition of programming and whether they feel the ability to write computer programs is a basic skill of the future; the kind of programming languages available; the background and abilities of teachers; and the emphasis given to proper programming techniques.

As important, decisions about whether or not to use microcomputers or computer terminals to teach programming skills depend on the availability of adequate equipment, enough classroom time for students to learn this skill, and suitable programming languages for children.

This last point is an important one to consider and usually means weighing the pros and cons of BASIC, the most common computer programming language.

There are other languages, not yet as common as BASIC, that some experts feel may be more appropriate teaching and programming languages for children. LOGO and Smalltalk are two good examples. But these languages are not yet in wide use. The next generation of microcomputers are expected to use LOGO to an increasing extent, but in the meantime, BASIC is likely to remain the major programming language option open to schools.

First the advantages. BASIC is well suited to small computers with limited capabilities, and is in wide use in a variety of similar dialects. It is also easier to write simple BASIC programs than it is to write simple programs in other languages. Students can learn simple programming quite easily with BASIC, which resembles spoken language in its flexibility and responsiveness.

But then BASIC also has some disadvantages. For example, it doesn't lend itself to complex programs. Complex BASIC programs, such as the ones teachers or high-school students might write, tend to be hard to understand for anyone other than the program's author. Over time, even the person who wrote the program may find it difficult to glance at the program and fully understand what was written.

Consequently, BASIC programs, when compared to other programming languages, can be difficult to modify, to correct, or even to learn from when compared to other programming languages.

Programming does require some abstract reasoning, which suggests it's more appropriately taught to older students. Then, too, programming requires typing skills typically mastered by older students. Consequently, programming is most frequently taught at the high-school level although there's increasing interest in earlier introduction.

6. Instructional Management. Using a microcomputer for instructional management shouldn't be confused with the administrative applications discussed next. Both are related. But in the case of instructional management applications, there is a direct link between administrative information provided by the microcomputer and what is taught during classroom instruction.

By and large, educators using a microcomputer as an instructional management tool use one kind of administrative information — students' test performance or achievement scores—to plan and tailor their instruction to meet students' needs.

This kind of microcomputer application is not yet widespread. However, many schools are already in the habit of machine-scoring standardized tests. The computer-generated profiles, which provide comparative information on students' performance, are used to make decisions about students' class assignments and to identify students in need of special instruction.

In addition, some schools already use computer-based instructional management in conjunction with drill and practice programs. Generally, the microcomputer analyzes answers from paper-and-pencil tests, gives the teacher a summary of each student's performance and maintains a record. In this way, it provides appropriate drill exercises tailored for the students who use the program.

Microcomputers also have the capability to generate individualized tests for students who type their answers into the equipment on the system's keyboard. And, with the aid of an optical scanner which can be hooked up to the system, a microcomputer can score answers on worksheets, quizzes, or tests for the whole class. It can then generate individual profiles of students' performance.

In the final analysis, a microcomputer can be a useful instructional management tool for educators, particularly if they want to use information on students' performance to guide their planning and their selection of individualized learning activities for students.

7. Administration. Interest in using microcomputers to handle school districts' administrative chores continues to grow. In comparison to instructional applications, the use of microcomputers alone, or in combination with central office computers used for scheduling, grade reporting, recordkeeping, and accounting functions is fairly straightforward. These administrative functions also require fewer computers per school than in the case of computer-assisted instruction. Consequently, schools with a single microcomputer frequently find this application more feasible than using a single piece of equipment for instruction.

Several publishers are beginning to produce administrative software programs to perform a variety of administrative tasks, including tracking and reporting on attendance, enrollment, bus routing, payroll, personnel matters and school accounts. Again, as with other microcomputer software, administrative software pro-

grams are still in short supply. And the quality and cost varies.

Nevertheless, educators considering microcomputers have in the administrative applications an efficient and convenient way to handle a number of administrative tasks. Whether sole use of a microcomputer for administration justifies the investment is a decision you'll have to make based on your needs. But schools and districts planning a limited initial investment in hardware might consider it.

Organizing for Microcomputers

As you weigh what microcomputers might do for you against what you are likely to be able to accomplish with them, still another factor looms on the horizon — organizing for the microcomputer.

In the year 2000, each student in a class may have his or her own microcomputer or computer terminal to work at during the school day. But today's teachers, who generally do not have a microcomputer for each of their 25 to 35 students, face organizational challenges their future counterparts will be spared. Schools wishing to introduce computer technology into their classrooms have the difficult

task of incorporating a limited resource designed for use by a single student into a setting where students learn in small groups or as a whole class. That is, most programs for classroom use are written for use by one child at a time. The practical limitations of the equipment — small video display and a single keyboard — make use by more than one student difficult. But few, if any teachers, will have the luxury of one computer or terminal for each student.

Given these limitations, it takes some planning to effectively use microcomputers for instruction.

The survival manual offers a few suggestions. First, there are various ways to allocate the equipment. These include distributing it to individual classrooms on a permanent basis or rotating the microcomputer between several classrooms. Another option is to house the microcomputer in a central location such as a media center, math lab, or library and bring students to it rather than the other way around.

There are also creative ways to have more than one student use the microcomputer. For example, if the computer program's content permits, teachers can modify the program's directions so that two students can use the program simultaneously. Depending on the size of the computer screen, the microcomputer can be used for demonstration with larger groups of students.

Deciding How You'll Use a Microcomputer

What You Know That the Experts Don't

Realistically, busy educators don't have a lot of time to spend investigating computer technology, an investigation that can make huge demands on your time. Consequently, you'll need to decide how much time you'll want to devote to your investigation and to each of the survival skills included in this manual. You might consider spending a good portion of your time deciding how you're going to use the microcomputer. As is true in most other things, planning is a critical factor. Careful planning can go a long way to ensure that your experience with the technology is successful. Without planning, your foray into the world of computers could be disastrous.

Happily, the planning stage relies heavily on your experience and expertise as an educator. After all, this is where you sort out just what your technology needs are and how microcomputers (alone or in combination with computer terminals you may have already) might meet these needs. Who knows your own needs better than you?

The planning process also relies on your sense of how much technology your colleagues are going to accept gracefully. You, not the technology experts, are in a position to discern your colleagues' receptiveness and enthusiasm, or their skepticism and hostility. You also know what the school budget will support, and have a sense of both the demands on that budget, and the pressures from within and outside the district to invest in computer technology. Finally, you have access to the education grapevine which provides information about other educators' successes and sorrows with technology. You know others who have already gone through the labors you are only now beginning.

Planning Your Use of a Microcomputer

At the risk of making the planning process sound overly simple, the survival manual offers some getting-your-planning-off-the-ground strategies. These strategies build on survival tactics discussed in the previous chapter which you may wish to glance at if you haven't already.

What the manual offers is a preferred planning strategy. It's a strategy, we quickly add, that is based on an awareness that each district's or school's planning process is after all unique. Earlier we mentioned two extremes. In some cases, a strong central administration may be involved. Consequently, decisions concerning machine selection, and placement in schools are made top-down. At the other end of the spectrum are stories of individual parents or teachers acting alone or in concert, and sometimes with the cooperation of school and district staff, to introduce microcomputers in the classroom. Then there's a planning strategy that falls somewhere in the middle of two extremes. This has been labelled "the shared planning approach" by others who have examined how schools acquire computers.[5]

If you're in a position to adopt the shared planning approach, you might seriously consider it. If you're not, you may still find some elements in the approach you can use in your own situation.

If you plan your use of microcomputer technology for instruction using a shared planning approach, you'll:

1. Pull together existing talent and resources within your community, district and school to guide the planning process;
2. Study your district's or school's needs and how microcomputer technology might help address them; and
3. Seek outside advice and additional information as needed to help you develop and finalize your plan.

The planning steps outlined below assume the process will involve a host of people. Some will know little or nothing about microcomputers but will have a good sense of what your district or school needs to improve its instructional offerings. If they have an open mind about how to promote such improvement, they will be a valuable asset. Other people may know a great deal about microcomputers and share this expertise with the committee. Still others will have strong feelings about how, and how not, to use the technology.

The group might include teachers, administrators, librarians, parents, students, outside consultants, members of local computer clubs, a local microcomputer distributor, or just about anyone with the time and interest to get involved.

There are some advantages to the shared planning strat-

egy. For example, it provides a mechanism to build broad based support for the use of microcomputers since various constituencies in the school system are able to communicate with one another. Then too, you benefit from the range of expertise, points of view and experience people bring to the planning effort.

Of course, there are drawbacks as well. Committees or groups can study and study and study an issue and take no action. Or they may decide on a course of action relatively early on only to find their plan shelved because the key administrators and influential teachers were not involved in the planning.

The survival manual offers you some steps others have found helpful as they developed a plan for microcomputer use.

1. Put together a draft document describing all the functions the microcomputer will perform.

This appears to be a large first step. But, in fact, it may be the easiest step in the planning process. At this point you're brainstorming; generating a "wish list" of what the technology can do for you with input from a broad cross-section of people. Put concerns with the hardware capabilities, with the software, or even with the question of whether it is possible for a computer to complete the desired functions out of your mind for the moment. The notion here is to think as broadly as possible in the initial phases about the microcomputer's possibilities as a tool. For each function you develop, write down some brief statement or rationale explaining the function you want the microcomputer to perform.

Discuss with the people involved in the planning process the possible ways of using microcomputers in instruction. Start by identifying computer applications that could address what you know to be the needs and concerns of school staff. If you don't have a clear sense of these, ask your colleagues for their input.

To jog your thinking, you might refer to the survival manual's list of "Possible Microcomputer Uses" in the appendix.[6]

2. Estimate the budget available to support the microcomputer.

This can be a ballpark figure since its main purpose is to give you some sense of the upper limits of your planning process. Your resources will only support a finite number of microcomputers, computer programs, inservice training sessions, and extra equipment or materials.

In these days of budget constraints, this is a hard step in the planning process. It's probably wise to look for funds

within existing district, school or departmental budgets first. Finding sufficient funds may require convincing some teachers or departments to allocate some of their regular materials budget for microcomputers. Or it may involve persuading an administrator to part with some discretionary funds.

Although it's more and more difficult for small projects to find federal and state support, it's still worth a try, particularly after you've pursued internal funding sources. Or you might consider private assistance from parents' groups, local businesses, large corporations, or civic organizations. Support from these sources is likely to be in the form of equipment or services rather than money but it might help you augment your own resources.

3. Begin to narrow down the draft list of functions. Does the list developed in step 1 make sense to those who read it, even those who know little or nothing about computer technology? You might ask parents, students, and staff who have no particular computer expertise to review the list. Use their input to revise, expand, prioritize, and clarify the list's statements and explanations of functions.

You might invite others—particularly skeptical others—into the planning process at this point. In the final analysis, you may have to "sell your plan" to these people for the school or district to acquire the technology.

4. Share the list of microcomputer functions with people knowledgeable about microcomputers and their capabilities.

You might include some vendors at this point, along with other individuals and groups including consultants, microcomputer owners, and staff from a local college or university. These experts can provide information about the hardware needed for the applications you have in mind as well as some idea of what it will cost.

5. Finalize the original list of functions.

Restate the functions you want the microcomputer to perform and sketch out general specifications for computer hardware and software needed to do the job(s) you have outlined. Can you defend your planned list of uses based on the best available funding information on your district's or school's needs and support by key constituencies? If so, and everyone accepts it, this is the plan to which you'll refer. You may want to refine it further as you look carefully at the hardware and software.

Sorting out the Good Computer Programs from the Bad

Computer hardware is quite advanced and it's getting more sophisticated and less costly all the time. But the programs, particularly the instructional programs developed to run on the equipment, are quite a different matter. What might be possible in the future is very different from what is possible today given the current state of instructional software.

Much has been written about the problems of available instructional software. Many of the programs are uninteresting and repetitious. Many are disconnected packages unrelated to one another, to other instructional activities, or to specific textbooks. Since they are generally written by computer programmers rather than educators, many don't incorporate what educators know about instruction. They are, in fact, examples of poor instruction. Many are little more than computerized versions of the programmed instruction textbooks of the 1960s.

This is unfortunate because the advantage of microcomputers is *not* that they can teach multiplication tables, the names of state capitals, vocabulary skills and the like. Schools don't need microcomputers to teach this information. No, the advantage of microcomputers is the kind of software they can contain, software which uses the microcomputer's full instructional potential.

Ideally, software, not hardware, is at the heart of decisions educators make about computer technology. After all, technology is a tool educators use to carry out activities faster, cheaper, and better than they could without the technology. The wherewithal to perform these activities is contained in computer programs or software.

Regrettably, those who view technology as hardware, invest in computer equipment first and worry about the quality of the programs they'll run on the equipment later. Or aware of the scarce supply of high-quality computer-based programs, they invest in the equipment now and hope that more and better software will be on the market in a few years.

But the quality of microcomputer software is not likely to improve dramatically in the near future, particularly if educators don't demand improvements and make specific suggestions related to content, instruction, cost and other factors.

Using Your Educational Expertise to Judge Software

The software review questions in the appendix build on educators' instructional expertise, knowledge of their own needs, and understanding of their students.

If you are able to review a software package prior to purchase (a rare possibility), you may wish to use some or all of these questions to evaluate the package. If you plan to rely on published reviews in magazines, catalogs, and newsletters, you might consider the questions in the appendix as you read the reviews.

The questions utilize your expertise to:

1. Evaluate statements of the program's rationale, goals and objectives;
2. Examine the teaching procedures and instruction included in the program;
3. Evaluate the knowledge and information presented in the program for completeness, accuracy, and appropriateness for the students who will use the program;
4. Determine how easily students can operate the program, how much control they have to pace their learning, and how well they might enjoy working with the program;
5. Consider what subject matter teachers need to be experienced in to use the program, teachers' impressions

of the program, and the quality of any teacher materials included with the program;

6. Determine if any tests or quizzes included with the program adequately measure what the program teaches; and

7. Examine information on the program's effectiveness, the developers and any field testing completed during development.

For a complete list of questions related to each of these items, refer to "Instructional Software Review Questions" in the manual's appendix.[7]

Selecting the Right Microcomputer

If a quick glance at the survival manual's table of contents sent you directly to this chapter, stop. And before you continue, look at the manual's other seven chapters. The survival tactics discussed in those chapters come into play during hardware selection.

Selecting hardware is the last decision educators considering microcomputer technology should make. It's preceded by decisions about how you'll use a microcomputer, where you'll use the system, in what subject areas, with which students, and in conjunction with what kinds of software. These are all discussed in the survival manual's other chapters.

This final section of the manual offers strategies for dealing with microcomputer vendors and for comparing the features of different microcomputer systems.

Preparing for the Computer Vendors

Selecting microcomputer hardware is fraught with hazards. For example, you may select a microcomputer system only to find out that it cannot perform all the functions you need. Or you may find yourself stuck with equipment that frequently breaks down. You may also discover that the software programs you need are incompatible with your microcomputer.

Fortunately, you can minimize the hazards associated with selecting microcomputer hardware even before you talk to a vendor if you:

1. **Review planned microcomputer uses.** You might reconsider all the functions you want the microcomputer to perform. Of interest are the immediate functions and the long-range applications since it isn't always possible to expand a system at a later date.

The applications you have in mind form the backbone of a set of specifications for the microcomputer hardware. For example, projected uses will influence your decisions about the necessary number of machines or work stations, extra equipment such as printers, tv monitors, voice synthesizers, and the amount of "memory." The microcomputer's memory unit, where it stores information, will have to be large if you plan a variety of uses. On the other hand, if you plan to interface or hook up the microcomputer to a large or mainframe computer, you'll think differently about memory. In this case, the microcomputer's capacity will be affected by the capabilities of the larger system.

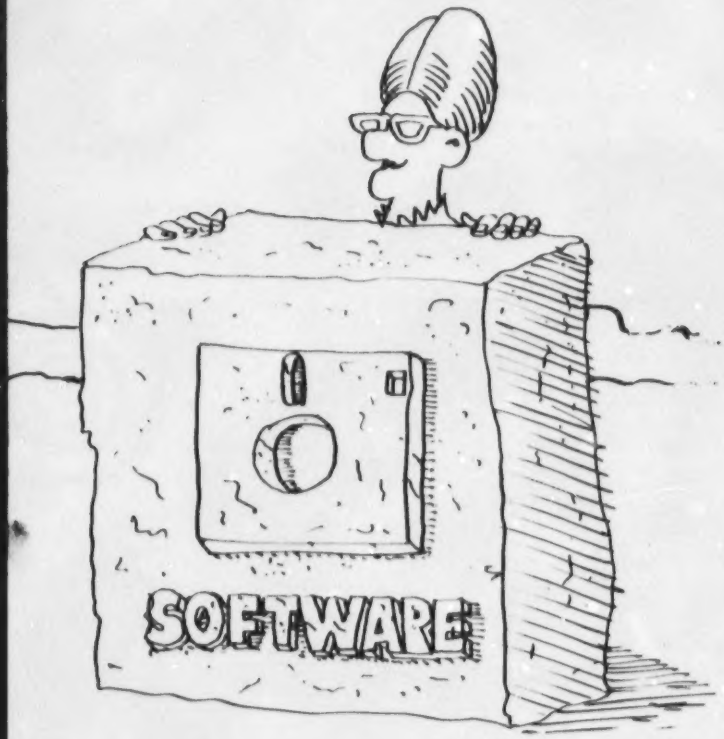
2. **Review decisions about software.** Once you find the software you want, the choice of hardware may be fairly painless. In the simplest case, you will find the perfect

software and it will be available for only one machine. Great. On the other hand, there may be more than one package that meets your needs and each may be written for a different microcomputer. Or the same manufacturer may sell the same package for several machines. Consequently, your decisions about software may only narrow the field of computer hardware from which you'll choose.

3. Review decisions about priority uses. If you're planning for multiple applications, a priority list of uses and users may well separate the hardware features and extra equipment you'll want immediately from those you want to add later.

4. Match the hardware's capabilities to your needs. You may or may not want some of the hardware capabilities available on most of the popular microcomputers. Again, your needs and the projected hardware applications are the deciding factors. For example, color, animation, and sound may be superfluous for a microcomputer purchased for word processing or administration. But they are valuable in game playing and in certain instructional applications.

Most of the microcomputers on the market have at least some graphics capabilities. But some go far beyond basics. You can invest in graphics printers and plotters to in-



crease the flexibility of both input and output.

Then too, some microcomputers have sound capabilities — a feature that adds greatly to game playing but isn't needed for bookkeeping. Others have music synthesizers for musical applications. You can choose any or all of these features plus others not listed here.

Talking To Computer Vendors

If you've followed the survival tactics in this manual, you should now be armed with the wherewithal to talk to microcomputer companies about how their hardware might help you accomplish the specific tasks you have in mind. In your conversations with vendors, you might wish to consider the following:

1. **Ask about the equipment's reliability.** Get the vendor's written commitment about repairs. Key questions to ask include: What kind of repair record system does the system have? Is there a local dealer who will repair the equipment? Will you be given a replacement or loaner system while yours is being repaired? What is the average repair time and cost? Must you bring the equipment to the dealer for all repairs and modifications?

Some machines have off-the-shelf packages which enable you to increase memory or change computer lan-

guages; others don't. Also, some machines claim to be "user serviceable." That is, the vendor says you can repair the system yourself with the assistance of a special program that diagnoses hardware problems. Be skeptical: these programs may diagnose only a limited number of hardware problems.

2. **Ask About User Training.** Little more than an operator's guide may accompany the microcomputer system you purchase or lease. That may be okay if staff unfamiliar with the equipment can acquire the needed training through courses offered by the district, local college, or some other organization. If these alternatives are not available, your new microcomputer may sit unused in the corner of a storeroom. Some vendors do offer orientation and training for educators through visitations to schools, informal presentations, meetings with school staff, and even formal training and classes. Some offer training at no extra cost; others offer it free to a limited number of staff members; still others charge extra for this service. Only you can judge if your colleagues want, need, or would like such training, but it certainly makes sense to ask about it.

3. **Consider only those systems in wide use.** First, there's a greater chance of getting good repair service and securing some kind of inservice training for staff from vendors whose equipment is in wide use in schools. Second, since computer software is generally not compatible from one machine to another, when you decide on a particular piece of hardware, you're also committing yourself to that system's software. Therefore, it's wise to go with a widely used microcomputer for which there is a large number of programs.

4. **Consider expansion options.** Many educators who buy microcomputers find that over time they outgrow the first system they buy. That is, they want more memory, a disk drive or two, a printer, or other extra devices.

The growth of any system is limited by the provisions its manufacturer has made for expansion. On some computers, phone lines, plotters or printers, can be attached by simply plugging in a cable. On others, you may have to purchase an expensive interface device before you can think of adding any extra equipment. Appropriate questions to ask yourself are: As your needs expand, can the system expand with them? How much does it cost to expand the system? Does the manufacturer support the expansion or are you on your own?

5. **Consider the pros and cons of various input formats.** Instructional packages used with microcomputers will normally come in one of three formats: cassette, floppy

disk, and less commonly, solid state cartridge. Cassettes store information in the same way as your standard cassette recorder. That is, information is stored sequentially as audio signals or beeps of sound. Consequently, to read the 40th item on the cassette, you have to read the first 39 items.

Floppy disks, on the other hand, provide random access so you can read information on one part of the disk without reviewing the preceding information. Consequently, information retrieval is quite fast. The disk itself has a smooth magnetic surface and information is stored on tracks through magnetic impulses. Generally, the disk has more storage capacity than the cassette, although it can be easily damaged and requires careful handling.

You'll have to weigh the pros and cons of various input devices. When you decide on one type, you'll have to stick with it. If you buy a microcomputer with cassette input, for example, and the program you purchase is on a floppy disk, it cannot be used without an additional investment for a disk drive.

6. **Take a careful look at extra equipment.** Your planned uses for the microcomputer will help you select extra equipment. For example, if you decide to use the microcomputer to generate grade profiles in reading and math for students to take home to their parents, you'll need to invest in another piece of equipment: a printer to produce a paper print-out (referred to as hard copy).

In addition, the software you purchase may require specific add-ons such as a speech synthesizer, or a music ability. At the more mundane level, you might want to make sure a microcomputer used in the classroom while other activities are going on comes equipped with earphones!

Comparing Microcomputer Systems

And so begins your shopping around for the right microcomputer system that meets the needs and fulfills the functions you've identified while using the survival manual. If you've decided to purchase or lease even a single microcomputer, it's a good idea to prepare a set of hardware specifications. You may also want to solicit bids from a number of vendors, even if you've decided only one brand of equipment will meet your needs.

There are lots of ways to gather information on various microcomputer systems' capabilities. You could attend a computer exposition, visit local computer stores in order to operate and discuss the computers, and visit schools using microcomputer systems. You can read promotional literature, general interest computer magazines and talk to

people in user groups and consultants.

If you're wondering what you might ask about the various hardware systems, the survival manual suggests you consider the following 12 dimensions:

1. Cost
2. Flexibility
3. Keyboard Layout
4. Mainframe Interface
5. System Expansion and Additional Ports
6. Memory Capability
7. Graphics/Characters and Color
8. Extra Equipment
9. Software
10. Input and Output Devices
11. Execution and Loading Time
12. Servicing and User Training.

Each of these dimensions is explained in detail in "Criteria for Judging Microcomputer Hardware" in the appendix.[8] Some dimensions may be more important to you than others. Consequently, the survival manual's appendix also includes a procedure you can use to assign importance factors to each dimension based on your own needs. Refer to "Rating Hardware Systems."[9]

A Final Word

Choosing a microcomputer, the final step in the decision process we've outlined, brings you to the end of *The Educator's Unauthorized Microcomputer Survival Manual*.

We hope the manual has helped you make decisions about how, when, where, and even if, you want to use microcomputers in instruction.

For additional information and assistance, you may wish to contact the organizations that produced this publication. They're listed in the appendix under "CEDaR-Member Institutions." Or you may wish to contact CEDaR for a list of computer resources for educators, a companion piece to the survival manual. This guide lists publications, products, services and training available from CEDaR's member organizations.

Appendix

A Short Guide To Computer Terms

ACCESS TIME. The period of time between calling for information from memory and the delivery of that information. Disk storage is generally faster than tape storage.

ACOUSTIC COUPLER. A device attached to a computer terminal to transmit and receive audio tones via telephone lines. A type of modem. See MODEM.

ARCHITECTURE. The internal, present arrangement or organization of a computer that determines how the computer operates.

ARTIFICIAL INTELLIGENCE: A branch of computer science aimed at developing machines capable of carrying out functions normally associated with human intelligence (e.g., reasoning, self-correction, adaptation).

BASIC. An acronym for Beginners All-Purpose Symbolic Instruction Code. A high-level conversational, interpretive, programming language in wide use. Always written in capital letters, BASIC permits the use of simple English words and common mathematical symbols to perform the necessary arithmetic and logical operations to solve problems.

BAUD. A rate of information flow. Given in bits per second (BPS), the rate is the highest number of single elements (bits) that a microcomputer, word processor or computer is capable of transferring in one second to another device. Alphabetic characters, for example, being transferred at 300 baud correspond to about 30 characters per second. Common baud rates are 110, 150, 300, 600, and 1,200 bps.

BINARY CODE. A code that uses only zeros and ones to represent data. 10110011, for example, may represent the letter C.

BIT. Binary Digit. The smallest unit of digital information.

BOOT: Short for "bootstrap." The process of loading the operating system of a computer into main memory and commencing operation.

BRANCH. A place in a program where a choice is made to depart from the normal sequence of program instructions. The departure is made by a "branching instruction" in the program. A branching instruction may be one of two types: conditional or unconditional.

BUFFER. A space in a computer system where information is temporarily stored. Usually used to store small sections of data during a transfer process. For example, data may be read from a tape cassette in small units, placed in a buffer, then transferred to main memory when the computer is ready to process the data.

BUG. An error in programming which causes faulty output. May also mean a hardware malfunction or design error in the computer or in its peripherals.

BYTE. A basic unit of information in a computer. Commonly consists of a sequence of eight binary bits, usually handled as a unit. One byte usually represents one character.

BPS. Bits per second.

CASSETTE RECORDER. A device for storing information. Because most computers lose the information stored in them when they are turned off, a means of keeping the information is necessary. Binary information is stored on a cassette tape by first converting it to audio signals and recording it on the tape. This method of storage is slower than disks.

CHARACTER. Single items that can be arranged in groups to stand for information. There are two forms: 1) numbers, letters, graphic symbols, etc., that can be understood by human beings; and 2) groups of binary digits that can be understood by the computer. A character is usually represented by one byte.

CHIP. A small, flat piece of silicon on which electronic circuits are etched. The heart of a microcomputer, this microprocessor contains all the circuitry to carry out computer operations.

CODING. Developing a set of computer instructions.

COMMAND. An instruction given to the computer through an input device or peripheral.

COMPATIBILITY. There are two types of compatibility: software and hardware. Software compatibility refers to the ability to run programs on a variety of computers without changing the program language. Hardware compatibility means that various components (printers, disks, keyboards, etc.) may be connected directly without intervening electronic devices and that all components use the same baud rate, word length, and other technical aspects in order to communicate.

COMPUTER. A device designed for the input, storage, manipulation, and output of symbols (digits, letters, punctuation). It can automatically follow a step-by-step set of instructions to manipulate information. The set of instructions and the information on which the instructions operate usually vary from one moment to another. The difference between a computer and a programmable calculator is that the computer can manipulate text and numbers; the calculator can manipulate only numbers.

COURSEWARE. A combination of content, instructional design, and the physical program, software, which causes a computer to complete instructions.

CPU. The Central Processing Unit. The CPU controls what the computer does. It includes three main sections: arithmetic, control, and the logic elements. It performs computations and directs the functions of the computer.

CRT. The Cathode Ray Tube is similar to a television screen. The CRT terminal usually is accompanied by a keyboard used to enter information into the computer. See MONITOR.

CURSOR. Usually a blinking indicator on the CRT that shows the user where the next character is to be typed and where it will appear.

DAISY PRINT WHEEL. A printer which has a wheel mechanism, with characters on the perimeter of the wheel. The wheel rotates to place the appropriate character in print position. A "hammer" strikes the character, forcing it against a ribbon, thereby forming an impression on the paper. The daisy wheel printer has the reputation of great reliability, is relatively inexpensive, and forms a solid character on paper.

DATA. The information given to or received from a computer.

DATABASE: Performing a programmed sequence of operations on a body of data to achieve a given result. Also refers to the computer's manipulation of large amounts of data.

DEBUG. Process of finding, locating, and correcting errors in a program that might create problems or provide inaccurate information.

DIAGNOSTIC ROUTINE/PROGRAM. A program that will check out the hardware and peripherals for incorrect information and breakdown.

DIALECTS: Different versions of the same computer language.

DISK (DISC). Magnetic coated material in a 5" or 8" record-like shape on which information and programs are stored. Since the information is stored randomly it can be accessed faster than on cassette storage. Sometimes called diskettes or floppy disks.

DOCUMENT. A written description of a piece of software or hardware. It gives the directions to operate a program or piece of equipment.

DOS. Disk Operating System. A set of programs and instructions that permit interaction between the diskettes and the microcomputer.

EDITOR. A program that allows changing, modification, or movement of programming statements. It allows the pro-

grammer to write and modify instructions using the microprocessor and a terminal as a very sophisticated typewriter.

EXECUTE. The running of a computer program.

FLOPPY DISK (DISC) SYSTEM. A device for storing masses of information on a rotating, flexible metallic-coated plastic disk which is similar to a 45 rpm record. Information can be stored and quickly retrieved. Unlike cassette tape, on which all information must be scanned, the disk allows the user to go to any section of the disk without searching through intermediate information.

FORTRAN. Science-oriented program language.

GIGO. Garbage in, garbage out. If incorrect information is put into the computer, the output will be misinformation.

GRAPHICS. Characters used to create figures, shapes, and forms on the CRT or printer.

HARDCOPY. Data or information printed on paper. Used to distinguish between printed information and the temporary image found on the CRT.

HARD DISK DRIVE: A peripheral device for storing programs or other information on disks made of rigid aluminum, coated with a magnetic recording surface. The most common form of storage on large computer systems.

HARDWARE. The physical equipment that goes into a computer system, consisting of the central processing unit plus all peripherals.

INPUT. Information going into the computer or into a peripheral device. The same data may be output from one part of the computer and input to some other part of the computer. When using this word, specify what the data are input to or output from.

INTELLIGENT TERMINAL. Terminal with built-in programmable intelligence enabling it to pre-process information and/or instructions without the aid of a CPU.

INTERFACE. Electronic circuit that connects the CPU and a peripheral device, disk drive, etc., permitting the flow of data back and forth.

INTERPRETER. A program used to translate various computer languages.

I/O. Input/Output of information in a computer system. Examples of I/O devices are: a keyboard, a floppy disk drive, a printer.

KEYBOARD. A device for typing information into a computer. It is similar in design and function to a typewriter keyboard. A computer keyboard has several additional keys for specific computer functions.

LANGUAGE. A format that allows a programmer to communicate more efficiently with a computer where predetermined commands will give requested actions. BASIC is one of the most popular languages. A language is a defined group of representative characters or symbols, combined with specific rules necessary for their interpretation. The rules enable an assembler or compiler to translate the characters into forms (such as digits) meaningful to a machine, system, or a process.

LOAD: To enter a program into the memory of a computer from a peripheral storage device.

LOG IN or LOG ON: A sign-on procedure for users of time-sharing systems.

LOGO: A high-level, interpretive language developed at the Massachusetts Institute of Technology almost 15 years ago.

MEMORY. The integrated circuit of a computer that can execute instructions. It is one component of a microcomputer. It is the brains of the central processing unit (CPU).

MICROCOMPUTER: A computer whose central processing unit is a microprocessor.

MICROPROCESSOR: An integrated circuit that executes instructions. Also, a central processing unit on a single chip. A computer whose main CPU is a microprocessor is called a microcomputer.

MODEM. An abbreviation for "MOdulator-DEModulator." It is a device which permits computers to transmit information over regular telephone lines.

MONITOR. A video display unit which uses a cathode ray tube to generate characters. It looks much like a normal TV set; however, the monitor has a much higher degree of resolution, which permits a clear formation of very small characters on the screen. See CRT (Cathode Ray Tube).

NOISE. Inaccurate data transmission.

OFF-LINE. Refers to data which are stored in devices not immediately accessible to the computer. Data stored on magnetic tape, punched cards, or paper tape must be loaded into on-line storage to be available to the computer.

ON-LINE. Refers to the location of data on storage devices which are immediately accessible to the computer. Usually on-line data are stored on discs, in RAM, or in ROM.

OUTPUT. Information coming from the microcomputer to a display unit, such as a CRT or printer.

PERIPHERAL DEVICE. A device, such as a printer, disk drive, etc., which is an additional computer component.

PERSONAL COMPUTER. A microcomputer designed for instructional uses, entertainment, or personal record-keeping.

PLOTTER. A device that draws on paper two dimensional shapes and designs.

PRINTER. A peripheral device that accepts output data from the microcomputer and prints it on paper. Printers are defined as impact or non-impact. Impact printers strike the paper by a ribbon like a typewriter's. Non-impact printers form characters by electrical charges, or spraying ink.

PROGRAM. A series of instructions to the computer which causes the computer to perform an operation.

PROM: Programmable Read Only Memory. A version of Read Only Memory (ROM) that can be programmed by the user. PROM cannot be changed or erased once it is programmed.

RAM: Random Access Memory. The computer's general purpose memory. RAM may be written into or read from the central processing unit. RAM can be erased and reprogrammed by the programmer as frequently as necessary. It is volatile. That is, it disappears when power to the computer is turned off.

RESPONSE TIME. The time interval required for the microprocessor to respond to an instruction or input device.

ROM. Read Only Memory. A circuit where data or instructions are programmed at the time of manufacture. ROM cannot be erased during normal operations. ROM is fixed, not volatile.

SOFTWARE. Refers to programs and accompanying documentation. Software is stored on tape cassettes or discs when not being used by the computer. The computer reads the software into its memory in order to use the programs.

STORAGE CAPACITY. The quantity of bytes a storage unit can hold. It is usually expressed in kilobytes. A diskette with 48K (48,000 bytes) for example, has approximately 48,000 characters, letters, numbers, spaces, or symbols.

STORE. Placing information in a storage device.

TAPE. The most common microcomputer tape is magnetic, such as cassette tape. Magnetic tape is stored in electrical charge patterns that are equivalent to what we know as letters, numbers, symbols, etc.

TERMINAL. A peripheral device which facilitates human communication with a computer. Usually it consists of a keyboard with alphabetic and numeric characters coupled with a printing mechanism or a CRT. One enters informa-

tion via the keyboard; the computer responds via the printer or CRT.

TIMESHARING. The simultaneous use of a central processing unit by two or more users, often remote from the CPU and each other.

TEXT EDITOR: A system of programs which facilitate editing. The functions available usually consist of adding text, deleting text, searching for specified text, paragraphing, and page layout.

VIDEO DISPLAY UNIT. A component of a microcomputer system which displays the output on a screen similar to a TV screen. A television monitor is a type of video display unit.

Possible Microcomputer Uses

1. Instructional Uses

Subject Areas

____ math
____ reading
____ language arts
____ science (specify: _____)
____ English
____ social studies
____ health
____ foreign language (specify:_____)
____ business education
____ guidance
____ library science
____ industrial arts
____ other _____
____ other _____
____ other _____

Application

____ testing
____ computer literacy
____ drill and practice
____ instructional management
____ tutorial dialogue
____ programming
____ discovery learning/simulation
____ graphics development
____ musical exploration
____ other _____
____ other _____
____ other _____

2. Non-instructional Uses

____ attendance
____ class registration
____ inventory
____ scheduling
____ bus routing
____ word processing
____ teacher assignments
____ college selection
____ budget
____ maintenance
____ library circulation
____ library card file
____ grade reporting
____ guidance records
____ payroll
____ personnel
____ other _____
____ other _____
____ other _____

3. Location

(Indicate the number needed at each location)

____ classroom (permanent)
____ classroom (shared-mobile)
____ library
____ business office
____ school office
____ guidance office
____ other _____
____ other _____
____ Total number of micros required

Instructional Software Review Questions

Rationale, Goals, Objectives

1. Is the program's rationale set forth clearly?
2. Does the rationale make sense?
3. Are the program's goals clearly stated?
4. Are the goals consistent with the program's rationale?
5. Are the goals appropriate for the students who will use the program?
6. Are there explicitly stated objectives corresponding to all the goals?
7. Do the objectives clearly communicate the developers' intent to the teacher?
8. Is the program compatible with your instructional objective(s)?
9. Will the program help you achieve your instructional objective(s)?

Content

1. Is the program's content accurate?
2. Is the content complete, and logically organized?
3. Is the range of skills included in the program sufficient to meet the program's objectives?
4. Do the skills match the needs and abilities of students who will use the program?

Instruction

1. Does the program use a sufficient variety of instructional strategies?
2. Are the program's objectives shared with students?
3. Are there ample opportunities to practice skills stated in the objectives?
4. Is the sequencing of instruction clear?
5. Are the materials free from sexual, social, or racial bias?
6. Does the program provide students with adequate feedback?
7. Is the form of the feedback and the response to student errors appropriate?
8. Does the program provide an adequate record of student performance?

The Student

1. Does the program's reading level match student ability level?
2. Is the program self-instructional or will it require teacher intervention?
3. Are instructions to students clear and easily understood?
4. Does the program offer students the option of stopping or exiting?
5. Can students control the duration of the display on the screen?
6. Is the typeface used in the program easy to read?
7. Are student interest and active involvement likely to be maintained?

The Teacher

1. How easily can teachers use the program and how easily can they incorporate the program into their instruction?
2. Does the program include materials for the teacher?
3. Are the teacher materials clearly organized?
4. Do the teacher materials explain the program's objectives?
5. Is the information contained in the teacher materials correct?
6. Are the teachers who will use the program familiar with the subject matter content?
7. Are the teachers reasonably convinced that their students can perform well in the program and that they will like it?
8. Do the teachers think the program's teacher materials give them sufficient orientation to operate the program in their classrooms?

Assessment

1. Do tests or assessments in the program adequately measure what the program teaches?
2. Is there a good match between the program's goals and assessment procedures?
3. Do the assessment procedures sample a reasonable portion of learning outcomes?
4. Are the most emphasized learning outcomes adequately assessed?
5. Are the items included in the tests carefully and correctly constructed?
6. Are a sufficient variety of procedures used to assess student performance?

Evaluation

1. Did the program go through a development cycle which included field testing?
2. Is a program evaluation report or report of field testing available?
3. Does the program provide evidence that:
   a. Students learn by engaging in the program's activities?
   b. Students learn what the program developers intend for them to learn?
   c. Students enjoy working with the program?
4. Who are the program's developers?
5. Do they have sufficient knowledge of instructional methods, the academic disciplines relevant to the program's content, and the characteristics of the learners who will use the program?

Cost

1. What is the program's purchase price?
2. What is the cost of consumable supplies/materials needed for the program?
3. What is the annual per pupil cost of the program?
4. What is the cost of any training necessary to prepare teachers to use the program?

Criteria for Judging Microcomputer Hardware

1. **Cost:** What is the total cost of the microcomputer? This includes price of any extra equipment you may purchase for the device (e.g., a printer), installation, and costs of cartage as well as the basic purchase price.
2. **Flexibility:** If necessary, can the unit be readily moved? Has it been tested for durability? How much does it weigh? Must the unit be near an outlet or telephone lines to operate? Do students have to be brought to the unit or can the unit be taken to students? Is there a need for special environmental controls (i.e., temperature, humidity, dust, protection from exterior electrical interference including other computers, static charges, another electromagnetic field)? Is a special electrical hook-up required?
3. **Mainframe Interface:** Does the unit have the ability to interface or connect with available mainframe computers? Do you require such capability?
4. **Keyboard Layout:** Most micros come with a standard typewriter layout. If the unit does not, will it fit your needs? Does it have a calculator layout? Is a calculator layout necessary or can the standard typewriter numbers fulfill your calculation needs?
5. **Additional Ports:** Can other devices be connected to the unit (e.g., printers, plotters, phone lines)? Are there sufficient ports to support the number of extra devices you need?
6. **Execution Time and Loading Speed:** How long does it take the microcomputer to execute an operation? How fast can information be loaded into the unit? Is the execution time, operation or loading of a program too long for students?
7. **Memory Capability:** How much ROM memory is the unit capable of? How much RAM memory can be taped?
8. **System Expansion:** Can the system be expanded easily? What are the limits of the expansion?
9. **Editing.** Can you edit as mistakes occur? Is editing simple? After the program is completed can you edit? Can you make changes in the program to suit your needs? Will the unit identify specific program errors?
10. **Input and Output Devices:** What input and output devices (e.g., cassette, disk, TV monitor, printer, plotter, graphics tablet, light pen, voice synthesizer) are included with the equipment?
11. **Software:** Are there sufficient manuals, reference and program materials available to support the microcomputer? Are programs suited to your needs available?

Have outside companies other than the original designer, made additional software programs? Is there enough software available to fulfill your needs? Can programs be modified to fulfill your needs? Have the programs been validated (field tested with students)? What is the cost of prepared programs?

12. **Graphics/Characters**: Is the unit capable of low or high resolution graphics? How many characters per line are available on the micro? How many lines on the display screen are visible? What is the screen size?

13. **Color**: Is color necessary for your operations? If so, will it require a special kind of monitor?

14. **Extra Equipment**: What kind of extra equipment is available (e.g., printer, voice synthesizer)? Do you need these extra devices?

15. **Servicing**: What warranties are available? Can the unit be serviced where you purchased it? Is on-site servicing available? Can local technicians make necessary repairs? For additional cost, will the unit be updated for the next year to reflect refinements? How long does it take for service including transportation to and from the service facility? What is the service charge including transportation?

16. **User Training**: Will the vendor provide on-site user training? At what cost? How many hours? For how many people?

Rating Hardware Systems

Directions: This sheet provides a common format to compare several microcomputers. To complete the form's four sections — comments, rank, importance, rating — follow the directions below.

Comments: Write notes about a particular microcomputer in this column.

Rank: Use a scale ranging from 1-5 to translate your comments about the system into a rank value. For example, if the cost is high, give it a 1. If the unit is easily moved, assign flexibility a rank of 5. If servicing is not available, give this category a 0.

Importance Factors: Numbers in this column reflect your needs and the applications you have in mind. Assign a number of 1-10 to each category. If your most important concern, for example, is the system's graphics capabilities, assign this category a 10. These weights reflect your needs and priorities. They should be applied to each system you're evaluating.

Rating: Multiply the rank value for each category (column C) by the importance factor (column D). For example if cost is of major importance (i.e., importance = 10) and the system's price is well within your budget (i.e., rank = 5), you would enter a 50 in the rating column next to cost.

Total Rating: For each microcomputer you investigate, add up the total number of points in the rating column. The higher the total points, the more a system conforms to your needs. But, compare the capabilities of two or three systems with similar ratings to note any categories you're willing to trade off for others.

Microcomputer Hardware Rating Sheet

Brand: _____ Model: _____

A. CRITERIA	B. COMMENTS	C. RANK (1-5)	D. IMPORTANCE (1-10)	RATING
1. Cost				
2. Flexibility				
3. Mainframe Interface				
4. Keyboard				
5. Additional Ports				
6. Execution Time & Loading Speed				
7. Memory Capacity				
8. System Expansion				
9. Editing				
10. Input & Output Devices				
11. Software				
12. Graphics & Characters				
13. Color				
14. Extra Equipment				
15. Servicing				
16. User Training				
			TOTAL	

References

1. These statistics are from *Instructional Use of Computers in Public Schools:* Fast Response Survey. September, 1982. Washington, D.C. National Center for Education Statistics.
2. These statistics and forecasts are taken from *Microcomputers in the Classroom —Dreams and Realities* (Report No. 319, Jan. 1982), by H. Becker, Center for Social Organization of Schools. Becker bases his statistics on a variety of sources including a survey by the National Center for Education Statistics, surveys by firms selling specialized lists of school personnel for marketing purposes, and discussions with persons in the field.
3. This glossary includes definitions appearing in *Take a Byte: A Guide to Computer Literacy for Teachers,* by R. Baillie, Y. Plowey, L. DeMarco Miller, J. Schmitt, and C. Holmberg, published by the Allegheny Intermediate Unit, Exceptional Children's Program, Pittsburgh, Pennsylvania, 1980; "A Selected Glossary of Terms Useful in Dealing with Computers," by C.H. Douglas and J.S. Edwards, *Educational Technology,* Oct. 1979, v.19, pp. 56-66.
4. This list and discussion of applications relied heavily on *Microcomputers in the Classroom — Dreams and Realities* (Report No. 319, Jan. 1982), by Becker, Center for Social Organization of Schools, Johns Hopkins University; *School Administrator's Introduction to Instructional Use of Computers* by D. Morsund, International Council for Computers, Le Grande, Oregon, 1980; and *A Bright Promise But A Dim Future: Researchers Examine Potential of Educational Technology,* M. Pitts (Ed.), Council for Educational Development and Research, Washington, DC, 1981.
5. A discussion of the political, personal and financial considerations in acquiring computers appears in *Practical Guide to Computers in Education,* by P. Coburn, P. Kelman, N. Roberts, T. Snyder, D. Watt, C. Weiner. Reading, Massachusetts: Addison-Wesley Publishing Company, 1982.
6. This list of possible microcomputer uses is based on lists appearing in *A Guide To Instructional Microcomputer Software,* by R. Baillie et al., Allegheny Intermediate Unit, Pittsburgh, Pennsylvania, 1980; *Micro-Ed Digest,* Feb. 1982, v.11, n.3, Two Star Systems, Inc., Mossistown, New Jersey.
7. The list of software review questions is a compilation of lists appearing in "Formative Evaluation in Science Curriculum," by A. Champagne and L. Klopfer, *Journal of Research in Science Teaching,* 1974, v.1, n.3, pp. 185-

203; and "Evaluation Criteria" appearing in the *Micro-SIFT Newsletter*, 1981, v.2, n.1, published by the Micro-SIFT Clearinghouse, Northwest Regional Educational Laboratory, Portland, Oregon.

8. This list of criteria to judge microcomputer hardware was taken from *A Guide To Instructional Microcomputer Software*, by R. Baillie et al., Allegheny Intermediate Unit, Pittsburgh, Pennsylvania, 1980.
9. Ibid.

Council for Educational Development and Research

The Council for Educational Development and Research (CEDaR) is a Washington-based association of nonprofit educational research and development institutions. The membership consists of eight university-based research and development centers and nine nonprofit educational r&d agencies.

The primary mission of the CEDaR-member institutions is to promote school improvement through their research, development, dissemination, and service activities. Each member produces new r&d knowledge; develops processes and products; provides direct r&d-based services to schools; and works with intermediate groups, agencies, and institutions.

CEDaR's quarterly publication, *Educational R&D Report*, presents to a nationwide audience indepth articles and brief summaries of the institutions' research and development. The publication is available from CEDaR free of charge.

Additional information about the work of the CEDaR members may be obtained either directly from the institutions, listed below, or through CEDaR.

CEDaR-Member Institutions

Appalachia Educational Laboratory
Terry L. Eidell, director
P.O. Box 1348
Charleston, West Virginia 25325
304/347-0400

CEMREL, Inc.
Lawrence D. Fish, president
3120 59th Street
St. Louis, Missouri 63139
314/781-2900

Center for Educational Policy and Management
Robert H. Mattson, director
College of Education
University of Oregon
Eugene, Oregon 97403
503/686-5173

Center for Social Organization of Schools
Edward McDill, James McPartland, co-directors
Johns Hopkins University
3505 N. Charles Street
Baltimore, Maryland 21218
301/366-3582

Center for the Study of Evaluation
Eva L. Baker, director
145 Moore Hall
UCLA Graduate School of Education
Los Angeles, California 90024
213/825-4711

Far West Laboratory for Educational Research and Development
John K. Hemphill, laboratory director
1855 Folsom Street
San Francisco, California 94103
415/565-3000

Institute for Research on Educational Finance and Governance
Henry M. Levin, director
CERAS Building, School of Education
Stanford University
Stanford, California 94305
415/497-1901

Learning Research and Development Center
Robert Glaser, Lauren Resnick, co-directors
3939 O'Hara Street
University of Pittsburgh
Pittsburgh, Pennsylvania 15260
412/624-4800

Mid-continent Regional Educational Laboratory
Lochran C. Nixon, Jr., executive director
4709 Belleview Avenue
Kansas City, Missouri 64112
816/756-2401

National Center for Research in Vocational Education
Robert E. Taylor, executive director
1960 Kenny Road
Ohio State University
Columbus, Ohio 43210
614/486-3655

The NETWORK, Inc.
David P. Crandall, executive director
290 South Main Street
Andover, Massachusetts 01810
617/470-1080

Northwest Regional Educational Laboratory
Robert R. Rath, executive director
300 S.W. Sixth Avenue
Portland, Oregon 97204
503/248-6800

Research and Development Center for Teacher Education
Oliver H. Bown, director
Education Annex 3.203
University of Texas at Austin
Austin, Texas 78712
512/471-1343

Research for Better Schools
John E. Hopkins, executive director
444 N. Third Street
Philadelphia, Pennsylvania 19123
215/574-9300

Southwest Educational Development Laboratory
Preston C. Kronkosky, executive director
211 E. Seventh Street
Austin, Texas 78701
512/476-6861

SWRL Educational Research and Development
Richard E. Schultz, executive director
4665 Lampson Avenue
Los Alamitos, California 90720
213/598-7661 or 714/821-7790

Wisconsin Center for Education Research
Marshall S. Smith, director
1025 W. Johnson Street
University of Wisconsin
Madison, Wisconsin 53706
608/263-4200

Council for Educational Development and Research
E. Joseph Schneider, executive director
1518 K Street, N.W.
Suite 206
Washington, DC 20005
202/638-3193

Index

Administrative applications of computers 15, 16
BASIC 13, 14
Budget 19, 21, 22
Computer-based programs 5, 9
Computer-generated achievement profiles 33
Computer hardware 5, 6, 28-34
Computer literacy, 6, 7, 12, 13
Computer programming 7, 13, 14, 15
Computer software 6, 9, 25-27
Computer terminology 3, 5
Drill and practice 10, 11
Equipment reliability 31, 32
Equipment repair 31
Evaluating microcomputer software 26-27
Extra equipment 29, 32
Hardware selection 49-51
Hardware specifications 33, 49-52
Housing the microcomputer 17
Incompatibility 39
Instructional expertise 19, 26-27
Instructional software 5, 25
Instructional software review questions 46, 47
Instructional uses of computers 9-16
Instructional management 14, 15
Instructional technology 11
Intelligent computer-assisted instruction 11
LOGO 14
Memory 29
Microcomputer revolution 1, 2,
Model building 12
Organizing for microcomputers 17
Peripherals (see extra equipment)
Planning microcomputer use 19-23, 29
Priority uses 22, 30
Problems with available microcomputer software 9-16, 25
Programming (see computer programming)
Programming languages 13-15
Simulations 12
Statistics on schools' use of computers 2-3
System expansion 39,40

Technology survival skill 1,5
Tutorial dialogue 11,12
User training 38-39
Vendors 34
Video display screen 22